At the commencement exercises of Lehigh University the following announcements were made: Robert W. Hall becomes lecturer on forestry as well as professor of biology; Barry MacNutt, assistant professor of physics, is made associate professor of physics; Percy Hughes, assistant professor of philosophy, psychology and education, becomes professor of philosophy and education in charge of the department; Vahan S. Babasinian, instructor in chemistry, becomes assistant professor; James Hunter Wily, instructor in physics, becomes assistant professor; R. J. Gilmore is appointed instructor in biology.

DISCUSSION AND CORRESPONDENCE

MINIMAL QUANTITIES OF FOOD PRESERVATIVES

A curious instance of a fallacious argument cast in pseudo-mathematical form appears in the evidence of Dr. Harvey W. Wiley before the Committee on Interstate and Foreign Commerce, House of Representatives, in February, 1906. The argument is repeated in more deliberate language (identical in the three) in Bulletin 84, Part II., of the Bureau of Chemistry, of the Department of Agriculture (1906), at p. 754, in Foods and their Adulterations (1907) at p. 38 and in the *Proceedings of the American Philosophical Society,* Vol. 47 (1908) at p. 326. As the latter publications are readily accessible to the scientific world, I shall quote only the informal statement of the argument before the committee of the house:

This is a graphic chart showing the comparative influence of foods and preservatives (Fig. 1). Of course we have to assume the data on which this chart is constructed. You will understand that.

We will suppose that a normal dose of a drug is nothing. We do not need it at all. Now imagine that the lethal dose of a drug—that is, the dose that will kill—is 100, and then we go to work and measure at three points—at 75, at 50 and at 25. These are points at which we can measure. We can not measure up towards the right there, because the line almost coincides with the basic line, and the deviation is so slight that no method of measurement that we know of could distinguish them.

I omit here some reference to an error in the diagram which appears to have been corrected before printing.

The lethal dose of that drug is 100. That is written up there on the left. I will just trace that. The normal dose of a drug in the case of a person in health is zero. Then if we use a little drug I can measure it here. I can measure it

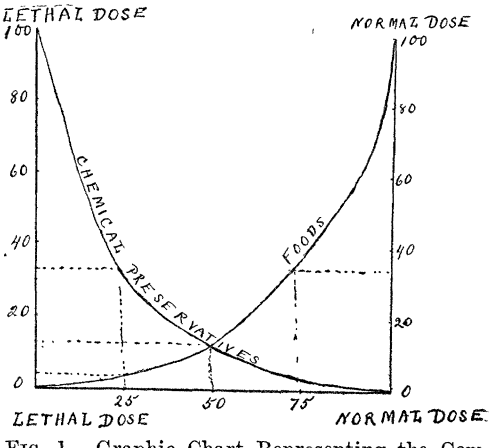

Fig. 1. Graphic Chart Representing the Comparative Influences of Foods and Preservatives.—Wiley.

again here (indicating) and I can measure it again here (indicating). Now from those three points I can construct a curve and calculate the lethal dose, which we will assume to be 100. That much drug would kill; no drug would not hurt at all.

The relative injury of a drug can be calculated mathematically from a curve constructed like that on experimental data, and I could tell you mathematically, by applying the calculus there, just what the hurtful value of that drug would be at an infinitely small distance from zero. You have doubtless, all of you, studied calculus, and you know how you can integrate a vanishing function. I used to know a good deal about calculus myself, and I could, by integral calculus, tell you the injurious power of a drug at an infinitely small distance from zero—that is, an infinitely small dose.

Now see what a contrast there is between a food and a drug.

The lethal dose of a food is none at all. That kills you; you are starved to death. The normal dose is what you eat normally, 100. I starve a man, and I measure the injury which he receives

at different points. I can mathematically plot the point where he will die.

That one chart shows to this committee in a graphic form, better than any argument could, the position of a drug in a food, as compared with the food itself. They are diametrically opposite. The lethal dose of one is the normal dose of the other, and *vice versa*. Therefore the argument de minimis as far as harmlessness is concerned is a wholly illogical and non-mathematical argument, and can be demonstrated by calculus to be so.

The reader is urged to refer to the more formal statement in either of the other publications, and to note the confusion of thought, by virtue of which deviation from the perpendicular line is (correctly) treated as the measure of injurious effects in the case of food, but deviation from the *horizontal* (!) line, as the measure in the case of drugs.

The argument contains three fallacies so patent that (to adapt words employed by the witness in criticism of those who hold the opposite opinion)[1] "it seems astonishing in these days of rigid scientific investigation that such fallacious reasoning can be seriously indulged in for the sake of proving" the *harmfulness* of minute quantities of non-condimental preservatives.

First and most important. Absolutely no evidence is offered that the curves actually have the form which is assumed for them.

Second. "Food = 0" can not be regarded as the lethal dose in the same sense that "preservative = 100" is a lethal dose.

Third. Quantity of food and injurious effects can not be measured in the *same direction* in a diagram purporting to show the relation between them.

It seems almost incredible that, repeated by the author as the argument has been over and over again during the past three years, recast in language, scanned by his assistants, none of these fallacies has been convincingly borne in upon his mind.

A lethal dose of any substance is the quantity which, administered at one time, is sufficient to cause death. To assume food = 0 a lethal dose is to assert the absurdity that food (and indeed every individual food substance) must be taken every minute of one's life. On the other hand, it is undoubtedly true that excessive quantities of food (and of individual foods) produce injurious effects. Logically, therefore, the food curve in Dr. Wiley's diagram, whether it refers to food in general or to any individual food, should—after touching the right vertical axis at "100 normal dose"—turn back to the left, and reach a true point of lethal dose at a point above 100. That is to say, it should have the general form represented by *ABC* in Fig. 2. If there be such a thing as a lethal dose of food, is it not the quantity represented by this point above 100 rather than the zero quantity? This diagram makes it clear that the cases of

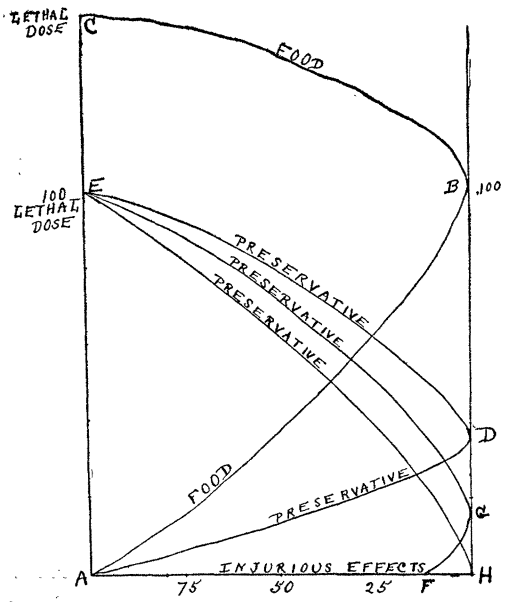

FIG. 2. Possible Forms of Curves Representing Injurious Effects of Foods and of Food Preservatives.

food and preservative are not diametrically opposite, as maintained by Dr. Wiley. Evidently the principle that any substance which is injurious in any quantity is injurious in all quantities, however small, is absurd as applied to food substances. And there seems no justification for laying down any principle "de minimis" which shall apply solely to preservatives or to non-condimental preservatives, or

[1] Page 249 of the evidence.

(most arbitrary limitation of all) to non-condimental preservatives not naturally present in the food.

In Fig. 2 are shown several possible forms for the preservative curve, alternate to the form given in Dr. Wiley's diagram. Two of these, *ADE* and *FGE*, represent the preservative as beneficial in small quantities and injurious in larger. The former represents the preservative as essential in some quantity; in other words, it would make the difference between food and preservative one of quantity merely, not one of kind. A curve of this kind is conceivable for a preservative such as benzoic acid or salicylic acid, both of which are normally present in minute quantities in many fruits.

The writer does not mean to assert that the curves for any preservatives have been shown to have the forms represented in Fig. 2. What he does wish to emphasize is that there is nothing in the mathematics of the case requiring them to have the form represented in Dr. Wiley's diagram, and therefore no justification for the argument that chemically preserved foods are injurious because the preservatives produce injurious effects when administered in quantities larger than would be contained in chemically preserved foods.

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The Chalk Formations of Northeast Texas

In the *American Journal of Science* for May, 1909, Article XXIX. is entitled "The Chalk Formations of Northeast Texas," by Mr. C. H. Gordon, the substance of which is to prove that the two formations of Texas, originally defined by me as the Austin chalk and the Anona chalk, are identical.

If such is the case, and I have long believed that it might be so, Mr. Gordon would do a service to science in proving the fact. I think, however, that in this paper where the author has entered into the question of record, his statements are neither complete nor accurate.

I spent many years of my life in endeavoring to define the many Cretaceous formations of my state, and to disentangle them from previous confusion. The various contributions thereon were progressive, and after the date of the last paper cited (1893) by Mr. Gordon as coming from me and before I retired from the subject, I learned and published much. A final work was published in which the previous results were summarized and errors corrected. Furthermore, the uncertainty as to the position of the Anona chalk was clearly stated. It certainly would seem a matter of justice for Mr. Gordon, in citing my views, to cite the latest published ones.

In the final work alluded to I clearly stated on page 341:

> That the writer has considered this chalk (Anona) to represent a higher horizon than the Austin chalk, but its exact relationship is a subject of future determination.

Also on page 337 I note the difficulty "owing to the lack of (continuous) outcropping sections" of separating the Austin chalk from the Navarre formations in the Red River district.

Furthermore, in discussing the correlation south of Red River of the various members of the Upper Cretaceous in northeastern Texas, I confessed my "utter inability, notwithstanding the years of study, to correlate the various outcrops of these beds, nor can it be done by minute paleontologic research, such as he (the author) has not had opportunity to undertake," and such as Mr. Gordon confesses he has not undertaken.

Mr. Gordon does not even mention the paper above quoted, which was my last work on the Cretaceous and which is entitled "Geography and Geology of the Black and Grand Prairies, Texas, Twenty-first Annual Report of the United States Geological Survey," Washington, D. C., 1902.

So far as the writer is concerned, it is a pleasure to see other workers continue the researches in the geology of Texas, where there are hundreds of problems and details still unsolved and unrecorded, but I do think it fair that if an author endeavors to present a record of previous researches, and opinions, that they should be cited fairly. The score or